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common with the *lumbricales*, into the extensor aponeurosis, and so to the middle and extreme phalanges. He looks upon this as one characteristic distinction between the hand and foot. In the arrangement which the author believes to be almost general in respect to the insertion of the *interossei* in the foot, and which supports essentially Mr. Huxley's view, it will be found that the bulk of each tendon is implanted into the base of the first phalanx, blending with the lateral ligaments of the metatarso-phalangeal joint, while only a few of the dorsal fibres are sent upwards and forwards, to meet and blend with the slips sent down to the sides of the joint from the extensor aponeurosis. These are not, however, so distinct and powerful as we find them in the hand, and, in their thin and scattered appearance, differ entirely from the insertion of the *lumbricales* tendons into the more forward part of the same extensor aponeurosis.

“On New Cornish Minerals of the Brochantite Group.” By Professor N. STORY MASKELYNE, M.A., Keeper of the Mineral Department, British Museum. Communicated by A. M. STORY MASKELYNE, M.A. Received February 13, 1865\*.

In March last my attention was drawn to a very small specimen of Killas, with some minute blue crystals on it, associated with a few equally small green crystals. The latter I proceeded to investigate with the goniometer. They proved to have almost identical angles with Atacamite, and, presuming them to be crystals of that mineral, I neglected them in order to measure the angles of the blue crystals. These proved also to belong to the prismatic system, and evidently were a new mineral. The specimen had come to the Museum from Mr. Talling, of Lostwithiel, a dealer from whom the National Collection has received a very large proportion of its finest Cornish minerals, and whose attention had been called to this specimen by the novelty of its appearance. Mr. Talling no sooner was apprised of the interest attached to his little fragment of Killas, than he set energetically about tracing it to its locality.

After a short time he succeeded in finding this locality; and though he has not yet divulged it, he soon forwarded other specimens to me at the British Museum. He has since found fine masses of the minerals, which are described in this memoir, and they are now in the collection under my charge.

The Killas which usually carries these minerals is of a very friable texture, often occurring as a breccia cemented by the minerals themselves, and at other times coated by them as incrustations.

Sometimes, however, they are found on it as minute crystals scattered over, and in direct contact with, the rock, or in a succession of layers deposited on it. In the latter mode of occurrence, the stone, whether Killas

\* Read February 23, 1865: see Abstract, p. 86.

or, as occasionally, a quartzose vein-stone, usually presents on its surface a very thin glaze of a greyish-white colour, and endowed with a remarkable metallic lustre. On this a thin layer, sometimes but  $\frac{1}{8}$ th of an inch in thickness, of the blue crystals is met with, and on that a thicker agglutinated mass of the same mineral of rather a paler blue colour. Sometimes this paler variety exhibits a very fine sky-blue colour, and assumes the form of foliations with the appearance of small and extremely thin crystals, which are, in fact, an aggregate of crystals generally twinned, and in the form of laminæ.

Above the whole is occasionally seen a coating, varying in thickness from an eighth to half an inch, of a faintly bluish- or greenish-white mineral with a fibrous, and sometimes a slightly foliated, structure.

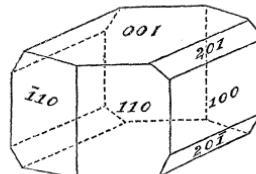
The place of the blue mineral is often taken by one of a fine green colour, varying from a dark emerald to verdigris-green, and often crystalline. Occasionally also crystals of Brochantite may be seen, sometimes in clusters, and occasionally also mixed with this green mineral.

### I. On Langite.

The first of these minerals that I propose to describe is that which occurs in crystals and crystalline masses, whether of the deeper or lighter lines of blue. I propose to call it Langite, in honour of my valued friend and late colleague Dr. Viktor von Lang, now Professor of Physics at Gratz.

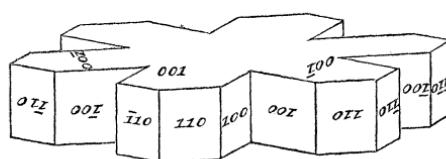
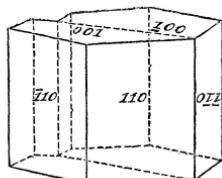
Langite crystallizes in very minute generally dark and somewhat greenish blue crystals belonging to the prismatic system, the ratios of the parameters being  $a : b : c = 1 : 0.5347 : 0.6346$ . The forms observed are (1 0 0), (0 0 1), (1 1 0), (2 0 1), and (0 1 0). The inclinations found between normals to thin planes being

|       |       |                       |
|-------|-------|-----------------------|
| 1 0 0 | 0 0 1 | = 90°                 |
| 1 1 0 | 1 1 0 | = 56 16               |
| 0 0 1 | 2 0 1 | = 51 46               |
| 1 1 0 | 2 0 1 | = 68 8                |
| 1 0 0 | 1 1 0 | = 61 46 61° 52' calc. |
| 1 0 0 | 0 1 0 | = 90                  |



The crystals are for the most part twinned similarly to those not unfrequent in cerussite: twin axes (1 1 0).

|       |         |       |           |
|-------|---------|-------|-----------|
| 1 1 0 | (1 1 0) | 1 1 0 | = 112 32' |
| 1 0 0 | (1 1 0) | 1 0 0 | = 123 44  |
| 1 1 0 | (1 1 0) | 1 1 0 | = 67 28   |



Cleavage parallel to 0 0 1 distinct; parallel to 1 0 0 nearly equally so. The plane 0 0 1 is brilliant; 1 0 0 rather less so, as is the rarer plane 0 1 0; the plane 1 1 0 sometimes exhibits hollows, the sides of which are parallel to the cleavages. The specific gravity of the mineral is 3.48 to 3.50. Its hardness less than 3. On looking through a section of one of these microscopic crystals of Langite, ground parallel to the plane [0 0 1] in the polarizing microscope, the plane of the optic axes is seen to be parallel to 1 0 0; but though coloured rings are visible, the axes lie beyond the field, and the double refraction is weak. Probably, however, the first mean line is the normal to 0 0 1, and it is negative. The symbol for its optical orientation would be

b c  $\bar{a}$ .

The crystals present dichroism:—

1st. As seen through 0 0 1 (along axis b c):

c (plane of polarization  $\parallel$  to 1 0 0) greenish blue.

b (plane of polarization  $\parallel$  to 0 1 0) blue.

2nd. As seen through 1 0 0 (along axis a):

c (plane of polarization  $\parallel$  to 0 0 1) darker bluish green.

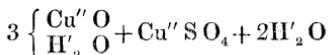
a (plane of polarization  $\parallel$  to 0 1 0) lighter bluish green.

It is a fact worthy of remark that Langite is geometrically isomorphous with Leadhillite.

Langite is insoluble in water, but readily soluble in acids and ammonia. When submitted to the action of heat, it loses its blue colour, turning at first bright green. As the heat is increased, it passes gradually through various darker hues of this colour, till it becomes of a dull olive-green, and ultimately black. Water is given off the whole of the time, which in the later stages of the change has an acid reaction. Before the blowpipe, it gives off water and acid fumes, colours the flame green, and becomes reduced to metallic copper with carbonate of soda on charcoal. The chemical composition of Langite is represented by the empirical formula,



which may be written as



The copper was determined in one case (i.) by precipitation on the interior of a platinum crucible, by means of a cell of a Grove's battery, a method that seems, however, to give the value of the metal in excess; in other cases (ii., iii., and iv.) by means of the volumetric method, wherein the iodine set free on precipitation of copper by an iodide is determined by means of starch and hyposulphite of soda. The sulphuric acid was determined in the usual way. The water in two cases (i. and ii.), by mixing the powdered and dried mineral with previously ignited carbonate of barium and heating the mixture in a combustion-tube in a current of dry

air, the liberated water being retained by sulphuric acid in pumice in a bulbous U-tube. In the other cases the mineral was heated with oxide of lead, and the water estimated by the loss.

From the slight differences in the numbers given by the sulphuric-acid determinations in these minerals, and from the difficulty of determining the values of traces of iron, lime, and impurities as disturbing elements in the calculation of the analysis, the water-determinations are especially important. The following are the numbers the analyses have yielded me—1st, crystals of Langite, carefully selected; and 2nd, of the much paler blue incrustation or aggregation of crystalline Langite, generally showing the plane 0 0 1 largely developed on the surfaces of the incrustation:—

*Copper-Determination.*

| I. Picked crystals.    |                 | Grammes.   | Per cent.     |
|------------------------|-----------------|--|---------------|
| i.                     | 0·2024          | gave 0·1074 copper, corresponding to . . . . .   | 53·06         |
| ii.                    | 0·2185          | took 18·18 cub. centims. of standard solution of hypo- sulphite of soda, corresponding to* . . . . . | 52·26         |
| iii.                   | 0·1866 , , 15·2 | ” ” ” ” ”  | 52·10         |
| II. Pale Blue Langite. |                 |  |               |
| iii.                   | 0·4295 , , 35·8 | ” ” ” ” ”  | 52·80         |
|                        |                 |  | Average=52·55 |

*Sulphuric Acid-Determination.*

| I. Picked crystals.    |   |                       |               |
|------------------------|---|-----------------------|---------------|
| 0·2746                 | gave 0·1297 Ba SO <sub>4</sub> , corresponding to 0·04457 | SO <sub>3</sub> . . . | =16·20        |
| 1·6687 , , 0·80475     | Ba SO <sub>4</sub> , corresponding to 0·27587             | SO <sub>3</sub> . . . | =16·23        |
| 0·288 , , 0·1375       | Ba SO <sub>4</sub> , corresponding to 0·0470085           | SO <sub>3</sub> . . . | =16·35        |
| II. Pale Blue Langite. |   |                       |               |
| 0·1701 , , 0·0826      | Ba SO <sub>4</sub> , corresponding to 0·028387            | SO <sub>3</sub> . . . | =16·61        |
| 0·4295 , , 0·2094      | Ba SO <sub>4</sub> , corresponding to 0·07196             | SO <sub>3</sub> . . . | =16·75        |
|                        |   |                       | Average=16·42 |

*Water-Determination.*

| I. Picked crystals.   |                                    |   |         |
|-----------------------|------------------------------------|---|---------|
| i.                    | 0·3622                             | lost . . . 0·0649 Water, corresponding to . . . . . | 17·93   |
| [ii.                  | 0·4737 , , 0·0915                  | ” ” ” ” ”   | 19·31]† |
| iii.                  | 0·7210 with oxide of lead 0·1326 . | ” ” ” ” ”   | 18·39   |
| II. Pale Blue Langite |                                    |   |         |
| iv.                   | 0·2258                             | 0·0423 . . . . .                                    | 18·73   |

Omitting the 2nd, the average=18·317

There are traces of lime and iron; of the latter I found in one experiment 0·03 per cent.

\* Two preliminary experiments with the standard solution on pure crystallized sulphate of copper and one on pure copper gave

99·66 per cent.  
99·965 , , } of the copper required by calculation.  
99·92 , , }

† A little acid came over in this experiment.

The formula  $3\text{Cu}^{II}\text{H}_2\text{O}_2 + \text{Cu}^{II}\text{SO}_4 + 2\text{H}_2\text{O}$  requires the following numbers \* :—

|                               |        | Calculated<br>percentage. | Average<br>found. |
|-------------------------------|--------|---------------------------|-------------------|
| 4 equivalents of copper ..... | 126.72 | = 52.00                   | 52.55             |
| 4 , , oxygen .....            | 32     | = 13.13 (calc.)           | 13.268)           |
| 1 , , sulphuric anhydride     | 40     | = 16.41                   | 16.42             |
| 5 , , water .....             | 45     | = 18.46                   | 18.317            |
|                               | <hr/>  | <hr/>                     | <hr/>             |
|                               | 243.72 | 100.00                    | 100.55            |

In order to determine the proportions of water on which the blue colour of the Langite depended, and, if possible, to obtain some insight into the nature, or, at least, the number, of the different degrees of the hydration, 1.6987 gramme of the crystals, after having been previously powdered and dried in dry blotting-paper, were heated in an air bath. The result was a loss:—

At  $100^{\circ}$  C. of  $0.02625 = 1.54$  per cent. water

Between 100 and 120 C. of .03825 = 2.25      "      "  
 120 and 140 C. of .03900 = 2.30      (begins to turn green).

140 and 180 C. of .0620 = 3.650

$$140 \text{ and } 180 \text{ C. of } 0620 = 3.636 \\ 180 \text{ and } 190 \text{ C. of } 0692 = 4.216 \quad " \quad "$$

190 and 220 C. of .096 = 5.651

250 C. of 1352 = 7.050

230 C. of 1352 = 7.959  
855 C. of 1403 = 8.854

$$255 \text{ C. of } 1402 = 8.254 \quad , \quad ,$$

$$260 \text{ C. of } 1472 = 8.616$$

290 C. decomposition.

2 equivs. of HO = 7.384

then of Langite under the influence of heat into a substance

formula  $3 \text{Cu}'' \text{H}'\text{O} + \text{Cu}'' \text{SO}_4 + \text{H}_2\text{O}$

1800°C and it would form

The passage, then, of Langite, under the influence of heat, into a substance with the formula  $3 \text{Cu}'' \text{H}_2\text{O}_2 + \text{Cu}'' \text{SO}_4 + \text{H}_2\text{O}$  would take place at a temperature of about  $180^\circ \text{C.}$ ; and it would further pass into a substance with the formula of Brochantite,  $3 \text{Cu}'' \text{H}_2\text{O}_2 + \text{Cu}'' \text{SO}_4$  at a temperature of about  $230^\circ$  or  $240^\circ \text{C.}$

A transition, however, so effected would probably be incompatible with a new crystalline structure in the mineral resulting from it, which would be, in fact, a pseudomorph.

The high temperature requisite for the expulsion of the last three equivalents of water, which cannot be performed without decomposition, would seem to give colour to the belief that this water is in more intimate association with the oxide, and forms with it a hydrate.

It is a fact worthy of remark that I have found one old specimen in which Langite is associated with Connellite. I convinced myself that the mineral was Langite by removing a crystal and measuring it. It gave the

\* I have adopted in this paper the doubled equivalents of all the elements involved in my formulæ, except hydrogen.

angle of the prism  $110, \bar{1}10 = 56^\circ 34'$ ,  $\bar{1}00 (110) \bar{1}00 = 124^\circ 10'$  (calculation requires  $123^\circ 44'$ ).

### II. *Waringtonite.*

The mineral to which I would next invite attention is one with a colour varying from emerald to verdigris-green that occurs sometimes mixed with Langite, but more often forming with it a continuous coating on the Killas or vein-stone, one part of this coating being in such cases Langite, and another part of it consisting of the mineral in question. At first I was in doubt whether this green body was not the result of the action of heat on Langite—in fact a pseudomorph after that mineral.

Subsequently, however, Mr. Talling sent me some unmistakeably crystalline specimens, and as at that time I had already made its analysis, there could no longer be any doubt that it was a new mineral.

I propose to call it “Waringtonite” in honour of my friend Mr. Warington Smyth, Inspector of Mines to the Crown Lands, and to the Duchy of Cornwall, &c.

The crystallography of Waringtonite presents a difficult problem, for the reason that it carries only one very distinct plane. The prevalent form of the crystals, which are almost microscopic, is that of a double curved wedge (or, to use a familiar illustration, like a stonemason’s double-edged hammer), the flat summit being formed by this distinct but narrow plane. That plane is characterized by great brilliancy, is bounded by curved outlines, and though often fissured near its extremities by the accumulation of two or more parallel crystals in optical contact at their centres, is otherwise without striation. If we call this plane, by its analogy to the brilliant and unstriated plain in Langite,  $001$ , and refer a very minute plane occasionally seen on the acute edges of the wedge to the form  $100$ , we find the planes  $010, 0\bar{1}0$ , and those in the zone  $[010, 001]$  represented by rounded surfaces, from which it is impossible to obtain any accurate measurements; and the prism planes in the zone  $[100, 010]$  are likewise much curved. There would seem to be two prisms in that zone, one of which forms a normal angle approximately determined as  $110, \bar{1}10 = 28^\circ 30'$  very nearly.

It is difficult to say whether Waringtonite is prismatic or oblique. The plane  $001$  forms an angle of  $90^\circ$  with those in the zone  $[010, 100]$ ; and the principal planes indicated by the planes of polarization, as seen on looking down the normal to  $010$ , are parallel to  $100$  and  $001$ ; but it is very difficult to speak with certainty as to the exact directions of the planes of polarization as seen when looking through the plane  $001$ , and as to the direction of a plane of polarization really bisecting the acute angles of the wedge.

The crystals often occur in interpenetrating forms, with the appearance of being twins.

The angles, however, between corresponding planes in the two individuals are not sufficiently uniform for the establishment of a twin plane.

The analysis of Waringtonite yields numbers that conduct us to the formula  $3 \text{Cu}'' \text{H}_2'\text{O}_2 + \text{Cu}''\text{SO}_4 + \text{H}_2'\text{O}$ , as the results which follow suffice to prove.

*Copper-Determination.*

| grammes.   | per cent.          |
|--|--------------------|
| i. '1925 yielded (by precipitation) . . . . .                            | '1054 copper=54·75 |
| ii. '334 took 29·20 c.c. of standard solution of hyposulphite sodium . . | =54·44             |
| iii. '320 , 27·40 " " "  | " . . =54·252      |
|  | Average=54·48      |

*Sulphuric Acid-Determination.*

|  |                               |
|--|-------------------------------|
| i. '2104 yielded '1001 grm. Ba SO <sub>4</sub> . . . . . | =16·22 SO <sub>3</sub>        |
| ii. '4201 " '2060 " " "                                  | =16·825 .                     |
| iii. '3200 " '16017 " " "                                | =17·16                        |
|  | Average=16·73 SO <sub>3</sub> |

*Water-Determination*

|   |             |
|---|-------------|
| (3) '4041 amorphous substance yielded when ignited with carbonate of barium . . . . . | '0607=14·18 |
| 2 '4891 picked crystalline Waringtonite . . . . .                                     | '0777=15·00 |
| 1 '3897 do. do. . . . .   | '0503=14·80 |
| 4 '5680 lost when ignited with oxide of lead . . . . .                                | '0806=14·19 |
| 5 '3707 do. do. do. . . . .   | '0540=14·56 |

Average, omitting the first, =14·64

I am indebted to Mr. Madan of Queen's College, Oxford, for the analyses i. and ii. in this Table, and the water-determination in analysis i. of Langite.

Like Langite, this mineral also contains traces of iron, lime, and magnesia. Of protoxide of iron I found in a very pure crystalline specimen of the mineral 0·14 per cent.

Crystals of Brochantite are often mixed with the Waringtonite, and the more amorphous forms of the green substance would seem to be mixtures of the two minerals.

The formula  $3 \text{Cu}'' \text{H}_2'\text{O}_2 + \text{Cu}''\text{SO}_4 + \text{H}_2\text{O}$  requires—

|                                   | Calculated percentage. | Average found. |
|-----------------------------------|------------------------|----------------|
| 4 equivalents of copper . . . . . | 126·72 = 53·99         | 54·48          |
| 4 " oxygen . . . . .              | 32 = 13·63 (calc.)     | 13·756         |
| 1 " sulphuric anhydride 40        | = 17·04                | 16·73          |
| 4 " water . . . . .               | 36 = 15·34             | 14·64          |
|                                   | 234·72 100·00          | 99·606         |

Like Langite, Waringtonite, though insoluble in water, is readily dissolved by acids and ammonia, and its behaviour before the blowpipe is similar to that of Langite.

Its specific gravity is 3·39 to 3·47.

Its hardness is 3 to 3·5. It abrades calcite, but not Arragonite. When a crystalline fragment is crushed between a cleavage face of celestine and a

smooth surface of porcelain or chalcedony, it leaves the celestine without perceptible abrasion. Brochantite, on the other hand, deeply cuts into that mineral.

In comparing the physical characters of these two minerals, one has furthermore to observe that, besides their differences in hardness and specific gravity (in Brochantite  $G=3.87-3.9$ ), their crystallographic habits are entirely dissimilar. Thus if we assume, for comparison's sake, the angle obtained for the normal inclination of the planes  $1\ 1\ 0$ ,  $\bar{1}\ 1\ 0$  in Waringtonite to correspond to that between  $e\ e'$  or  $1\ 0\ 1$ ,  $\bar{1}\ 0\ 1$  of Brooke and Miller in Brochantite, a point of view from which we see the two minerals in the most advantageous orientation for comparison, we shall find that the planes of the form  $(1\ 0\ 1)$  in Brochantite, like those of  $(1\ 1\ 0)$  in Waringtonite, are much curved; the plane  $1\ 0\ 0$ , however, is a well-marked plane in Brochantite, striated parallel to the zone-axis  $[0\ 0\ 1]$ . In Waringtonite the corresponding plane,  $0\ 1\ 0$ , is a curved surface without striation. The plane  $0\ 0\ 1$  is furthermore a most conspicuous plane in the latter mineral, while the analogous plane  $0\ 1\ 0$  in Brochantite is, I believe, unknown.

A mineral, described by Berthier (Ann. Chim. Phys. l. 360), and one recently analyzed by Domeyko (Annales des Mines, 1864, p. 460), gave the following percentage composition:—

|                        | Berthier. | Domeyko. | M. Pisani. | Waringtonite. |
|------------------------|-----------|----------|------------|---------------|
| Copper.....            | 52.85     | 55.89    | 54.9       | 54.48         |
| Oxygen .....           | 13.35     | 14.15    | 13.9       | 13.756        |
| Sulphuric anhydride .. | 16.6      | 16.15    | 17.2       | 16.73         |
| Water .....            | 17.2      | 13.81    | 13.2       | 14.64         |
|                        | 100.0     | 100.00   | 1.0        | 99.606        |
|                        |           |          | CaO .8     |               |
|                        |           |          |            | 101.0         |

In the third column of the above Table I have also given the results of M. Pisani's analysis of a green mineral which he found associated with Langite, and which was probably Waringtonite mixed with the ferruginous Killas (on which it often occurs). He assigned the mineral to Brochantite. Berthier's mineral from Mexico was probably Waringtonite containing hygrometric moisture, as by deducting two per cent. of water his analysis almost exactly accords with the numbers representing that mineral. The green fibrous mineral from the Cobre mines in the Atacama desert would seem, from the description of the eminent mineralogist of Chili, to be a mixed substance.

### III. *Atacamite.*

I have mentioned that the first specimen of Langite that came into my hands had upon it small bright green crystals of a mineral with the angles of Atacamite. These angles were the following:—

| Found.                 | Corresponding angles<br>in Atacamite. |
|------------------------|---------------------------------------|
| 1 1 1, 1 0 0 = 63° 48' | 63° 20'                               |
| 1 1 1, 1 1 0 = 36 27   | 36 18                                 |
| 1 0 0, 1 1 0 = 56 35   | 56 10                                 |
| 1 1 0, 1 1 0 = 66 50   | 67 40                                 |
| 1 0 1, 1 0 0 = 52 50   | 52 50                                 |
| 1 0 1, 1 0 1 = 74 20   | 74 20                                 |

Seen in polarized light through 1 0 0, the normal to 1 0 0 appears to be a bisectrix, and the plane of the optic axes is parallel to the edge 1 1 0, 1 0 0; and the crystal, as seen through 1 0 0, is negative.

It is dichroic, exhibiting—

a, = plane of polarization parallel to 0 0 1, grass-green.

b, = plane of polarization parallel to 0 1 0, more yellowish green.

There were but a very few of these minute, in fact microscopic crystals; but two of them I dissolved in nitric acid on a watch-glass, and tested them with nitrate of silver in the field of the microscope. A white cloud was at once struck in the solution, which, while refusing to dissolve in nitric acid, readily yielded to the solvent action of ammonia. This mineral then is Atacamite, as is confirmed by its apple-green streak. Since that time a mine in St. Just has produced this mineral, and I have from Mr. Talling a specimen from there which contains sulphate as well as chloride of copper. I hope soon to have the opportunity of effecting its analysis from purer specimens than such as have as yet been raised; for these consist of an intimate mixture, in which Atacamite, indeed, seems to be the preponderating ingredient, but in which, perhaps, Langite and Brochantite will prove also to be present.

“On the Rate of Passage of Crystalloids into and out of the Vascular and Non-vascular Textures of the Body.” By HENRY BENCE JONES, A.M., M.D., F.R.S. Received April 26, 1865\*.

It occurred to me that possibly, by means of the spectrum, I might trace the rate of passage of medicines into the vascular and non-vascular textures, and prove their presence, and determine the time during which they remain in action in some of the tissues far more accurately than had yet been done.

I was fortunate enough to obtain the assistance of Dr. A. Dupré, who had already published a paper in the Philosophical Magazine on the presence of lithium and strontium in the waters of London; and I am greatly indebted to him for carrying out all the suggestions which I thought requisite for proving how soon the salts of lithia pass into the different vascular and non-vascular textures of animals and of man, and how quickly

\* Read May 4, 1865; see Abstract, p. 220.